CONFERENCES-MYCOLOGICAL ...

Board of Agriculture in India

PROCEEDINGS

OF THE

Third Meeting of Mycological Workers in India

Held at Pusa on the 7th February 1921 and following days

IMP. MYCOLOGICAL BUREAU
7 SEP. 1921
OF MYCOLOGY

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1921

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FROM

S. MILLIGAN, ESQ., M.A., B.SC.,
Agricultural Adviser to the Government of India,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA,
DEPARTMENT OF REVENUE AND AGRICULTURE,
SIMLA.

Camp, Simla, the 30th May 1921.

SIR,

I have the honour to submit the Proceedings of the Third Meeting of Mycological Workers in India, held at Pusa on the 7th February, 1921, and following days. These proceedings have been recorded by Mr. J. F. Dastur, Officiating Second Imperial Mycologist, and Mr. M. Mitra, First Assistant to the Imperial Mycologist, who acted as Secretaries.

I have the honour to be,

SIR,

Your most obedient servant,

S. MILLIGAN,
Agricultural Adviser to the Government of India.

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THIRD MEETING OF MYCOLOGICAL WORKERS IN INDIA, 1921.

Third row : K. F. Kheshwalla, M. J. Narasimhan, K. D. Das, M. Mitra, R. R. Sen, S. Sundararaman, S. R. V. Mudaliyar, Md. Taslim, S. V. Shevde, A. Hafiz Khan, C. V. Sane, S. C. Bose.

Second row : S. R. Bose, P. K. Dey, S. L. Ajrekar, Major F. de Mello, A. Howard, F. J. F. Shaw, R. S. Hole, S. N. Bal, R. T. Pearl, S. K. Basu, J. F. Dastur.

First row : L. S. Bertus, L. S. Subramaniam, S. D. Joshi, G. S. Kulkarni, P. C. Kar, Md. Azmat Ullah Khan, J. C. Mukerjee, R. K. Bhide.

The Third Meeting of Mycolcgical Workers in India.

INTRODUCTORY.

The Third Meeting of the Mycological Workers in India was held at Pusa on the 7th February, 1921, and the following days, Dr. F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S., being Chairman.

Members.

The members present were :—

1. F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S., Officiating Imperial Mycologist. (Chairman.)
2. J. F. Dastur, M.Sc., D.I.C., Officiating Second Imperial Mycologist. (Secretary.)
3. M. Mitra, M.Sc., First Assistant to the Imperial Mycologist. (Secretary.)
4. R. S. Hole, F.C.H., F.L.S., F.E.S., Forest Botanist, Dehra Dun.
5. Major Froilano de Mello, Deputy Chief of the Board of Health, Nova Goa.
6. P. K. Dey, M.Sc., Plant Pathologist to the Government of United Provinces.
7. S. L. Ajrekar, B.A., Plant Pathologist to the Government of Bombay.
8. R. T. Pearl, B.Sc., A.R.C.S., Government Mycologist, Central Provinces.
9. S. Sundararaman, M.A., Acting Government Mycologist, Madras.
10. C. V. Sane, B.Ag., M.Sc., Director of Agriculture, Baroda State.
11. T. P. Pillai, Mycologist, Travancore.
12. W. Dudgeon, Ph.D., Professor of Botany, Ewing Christian College, Allahabad.
13. S. N. Bal, M.Sc., Assistant Professor of Botany, College of Science, Calcutta.
14. S. R. Bose, M.A., F.L.S., Professor of Botany, Carmichael Medical College, Calcutta.

15. S. K. Basu, M.A., Officiating Deputy Director of Agriculture, Bihar and Orissa.
16. S. V. Shevde, B.Sc., Professor of Biology, Baroda College, Baroda.
17. M. J. Narasimhan, B.A., Acting Senior Assistant Mycologist, Mysore.
18. S. C. Bose, Assistant Mycologist, Indian Tea Association.
19. G. S. Kulkarni, M.Ag., Assistant Professor of Mycology, Agricultural College, Poona.
20. S. R. Venkatakrishna Mudaliyar, B.A., Assistant in Mycology, Madras.
21. A. Hafiz Khan, Assistant to the Forest Botanist, Dehra Dun.
22. R. K. Bhide, Assistant Economic Botanist, Poona.
23. P. C. Kar, Mycological Assistant, Bengal.
24. L. S. Subramaniam, Assistant to the Imperial Mycologist.
25. K. F. Kheshwalla, B.A., Assistant to the Imperial Mycologist.
26. R. R. Sen, Assistant to the Imperial Mycologist.
27. Muhammad Taslim, Fieldman, Mycological Section, Pusa.
28. Muhammad Azmat Ullah Khan, Fieldman, Mycological Section, Pusa.
29. J. C. Mukerjee, Fieldman, Mycological Section, Pusa.
30. S. D. Joshi, B.Sc., Student, Mycological Section, Pusa.
31. L. S. Bertus, Student, Mycological Section, Pusa.

Visitors.

Mr. S. Milligan, M.A., B. Sc., Agricultural Adviser to the Government of India, and Mr. A. Howard, C.I.E., M.A., Imperial Economic Botanist, visited the conference at the opening session.

PROGRAMME.

The programme before the meeting consisted of :—

I.—Discussion on the Physiology of Disease.

II.—Survey of Diseases of Crops.

III.—Discussion on Spraying.

IV.—Mycological Education.

V.—Discussion on Legislation against Fungal Diseases and on the Imperial Bureau of Mycology.

A lecture on "Medical Mycology" by Major Froilano de Mello, Deputy Chief of the Board of Health, Nova Goa.

A Demonstration of Spraying Machinery.

PROCEEDINGS.

FIRST DAY.

Opening of Proceedings.

The Third Meeting of Mycological Workers in India was opened on the 7th February, 1921, by **Mr. S. Milligan,** M.A., B.Sc., Agricultural Adviser to the Government of India, who **in his introductory speech said :—**

"Dr. Shaw and Gentlemen : I have to extend to you all a very hearty welcome to Pusa. It is with real pleasure that I see such a large and representative attendance at our third conference, indicating as it does the increasing interest taken in mycological work in India. But although we are strong in numbers there are notable absentees from the ranks of those who attended our last meeting. Some are on leave and some are for other reasons unable to attend. But there remain the names of two of our most prominent members. I refer, of course, to Mr. Mackenna and Dr. Butler. Both have received that recognition of their services which was bound to come sooner or later, but the loss to agriculture in India is none the less. In Mr. Mackenna we have lost a chief who, although belonging to an administrative service, had the interests of the scientific sections of our department thoroughly at heart and whose genial personality gained him a popularity which has never been exceeded in the service to which most of us belong.

"The retirement of Dr. Butler is a severe blow to mycological work in India and in the tropics generally. We realize that we have lost a recognized authority in his own branch of science, a capable organizer of research, and a man who exerted a good influence wherever he went. It is, however, a matter for congratulation that the Imperial Bureau of Mycology has chosen for its first Director a man from the Indian Agricultural Service, and we hope that in his new post Dr. Butler will still be able to preserve his connection with India.

"I should next desire to wish you a profitable conference. Yours is a subject which is extremely technical and a full knowledge of which does not necessarily lead to immediate practical

results. In spite, however, of the enormous difficulty of applying remedial measures to growing crops, it is encouraging to those dealing with the economic side of the subject to know that much has been done to protect crops from disease by treatment of seed, by the spraying of growing crops, by the introduction of disease-resisting varieties and by suitable crop rotations. While, therefore, the difficulties are great, there still remain a sufficient number of well recognized methods of checking disease. The field for useful work is a very wide one and the amount of controllable loss due to fungus diseases throughout the world is still enormous.

"Yours is often said to be a protective branch of science. Protective it is, but if by protective we are to understand that it differs radically from any other branch in its application to agriculture, I am not sure that I agree.

"Is not all agriculture protective, and is not the main function of the agriculturist to nurse his plants? Does he not, in preparing his land, protect his crops against adverse conditions? Does he not carefully guard them against the competition of other plants, and have not the results of scientific work on steeping, spraying, rotations, etc., now become so incorporated into ordinary agricultural practice in the more advanced countries that their origin has almost been forgotten? Gentlemen, the checking of plant disease is no appendage to agriculture or forestry. It is a necessary and important part of it."

On the conclusion of Mr. Milligan's speech, **Dr. F. J. F. Shaw,** Officiating Imperial Mycologist, **addressed the meeting as follows :—**

"Mr. Milligan and Gentlemen: Since the last mycological conference there have been many changes in the band of mycological workers in India. At the risk of repeating what Mr. Milligan has already said I must mention our regret at the absence of Mr. Mackenna, and I must also voice the feeling of everyone here by giving early expression to the deep sense of personal loss of which we are all conscious in the absence of Dr. Butler from the chair of this meeting. We have, however, the satisfaction of knowing that, however unavailing our efforts may be to feel the gap created in the ranks of Indian mycologists, the wide knowledge and ripe scholarship which has done so much for the advancement of our science is still at our service in the Imperial Bureau of Mycology. We are all confident that under the direction of Dr. Butler the Imperial Bureau of Mycology will be of very great help and guidance to mycologists all over the Empire.

"The changes which have taken place have been chiefly in the direction of the expansion of provincial departments. The recommendation which was framed at our last conference with reference

to the mycological section in Bombay has been met by the appointment of Mr. Ajrekar as mycologist in that province, and the United Provinces and Central Provinces have also obtained mycologists.

"The present gathering of mycological workers in India differs in some important respects from either of the preceding meetings and indeed from any which are likely to succeed it. At the previous meeting there was hardly an officer present who had not been on continuous duty for at least four years prior to the meeting. At the present time practically all our senior officers are either on leave, or just back from leave, and of those who are new to this conference several are new also to their duties in this country. We are without the valued assistance in our discussions of Messrs. McRae, Anstead, Robertson Brown and Tunstall, and Mr. Dastur and myself have only just returned to duty. In some respects, therefore, we can hardly expect that our information on the mycological events of the last two years will be as complete as on former occasions. For this reason I think that we shall find three days sufficient for our deliberations and we might perhaps spend rather less time than usual on our crop disease survey, a subject on which we shall all have much more to say at our next meeting. In Subject III—Spraying—I shall have some information to give the meeting with regard to our experiments in 1919 in Kumaun and Peshawar and also on the results of my tour round the manufacturers of spraying machinery in England. We shall doubtless have further information from Bombay and Assam. In Subject IV we may perhaps include a consideration as to how the resources of the mycological laboratory in Pusa may best be made available for the help of other workers in the provinces—a point of considerable importance at the present moment when so many new departments of mycology are being established. Subject V, will, I hope, give us some information as to the working and administration of the Pest Act.

"I think that this is an appropriate moment to make some reference to the War Emergency Board of American Plant Pathologists, a body formed, during the recent conflict, with the special object of conserving food crops by reducing losses from disease. As Secretary to the last mycological conference it was my duty to transmit your first resolution to the War Emergency Board, and I have received the following reply from Dr. Wetzel:—

I beg to acknowledge with best thanks your letter of April 5th. You will be interested to know that the War Emergency Board, as such, has ceased to exist, but the work has been continued under the direction of a new board known as the Advisory Board of Plant Pathologists. Dr. G. R. Lyman, of the Bureau of Plant Industry, Washington, D. C., is the chairman of the new board. I am sending copy of letter to all the members of the new board.

"The objects of the Advisory Board of American Plant Pathologists are set forth in the final report of the War Emergency

Board, and are such as will, I am sure, command the support of every mycological worker in India. Our own mycological conferences I think cover, for India, most of these objects.

"In conclusion, I would extend on your behalf and mine a very hearty welcome to Mr. Hole, Forest Botanist, and to Mr. Howard, Imperial Economic Botanist, who are with us for the first time, and to all those who have recently joined the ranks of Indian mycologists, and I would add my personal appreciation in the case of two of my fellow workers, Mr. Dastur and Mr. Ajrekar, who are present in positions of enhanced responsibility. I ask you all to join with me in thanking Mr. Milligan for his opening address and for the interest which he has shown in this conference."

The meeting then proceeded to consider the first subject on the programme.

Subject I.—Discussion on the physiology of disease.

The Chairman requested Mr. Hole to open the discussion on this subject.

Mr. Hole said:—

"Mr. Chairman and Gentlemen: Just before I left Dehra Dun I received a request that I would make some remarks on the subject of the physiology of disease, and this note, such as it is, was put together yesterday in the train. In the first place, therefore, I desire to apologize for its shortcomings and hope you will make allowances for its deficiencies.

"On December 11th, 1919, the Association of Economic Biologists at home discussed the important question of the 'Integration of Mycological Research with practice in Agriculture, Horticulture and Forestry.' The opinions which were expressed at that meeting by men of recognized authority in their different lines of work are, I think, of the first importance for India to-day, with reference to the particular question now before us, and I hope, therefore, that you will allow me to draw your attention to them in case you have not yet all seen them.

"Two points were especially emphasized by a number of speakers, *viz.*, (1) the desirability of encouraging and promoting the study of physiology, and (2) the necessity for studying the plant in the field, *i.e.*, for carrying our physiological work beyond the laboratory and the greenhouse into the garden, the experimental area, the field, and the forest.

"In this connection I need only refer to the remarks made by—

"(1) Dr. E. J. Russell, Director of the Rothamsted Experimental Station, with reference to the agricultural problem:

In attempting to integrate mycological research with agriculture the great need of the present time is to study the growing plant in the field in health and in disease, both states being regarded as the resultant of the prevailing conditions.

* * * * * * * *

In the mycological problem three sets of factors are involved: the crop, the parasite, and the external conditions. External conditions can again be subdivided into soil and climatic conditions. At Rothamsted an attempt is being made to attack the problem on the following lines. The soil is being studied from the points of view of the chemist, the physicist, and the biologist; under the last heading separate investigators have charge of bacteria, protozoa, fungi, algæ, and helminths. The climatic conditions are difficult to study, but a start has been made by following up the work of Hooker at the Meteorological Office, who has indicated certain correlations between weather and crop yields and shown that the subject is susceptible of investigation.

* * * * * * * *

The practical problems in plant disease differ sharply from those presented to the horticulturist and the human doctor; the farmer's plants are so numerous that he cannot hope to give them individual attention but can only treat them in the mass. The elucidation of the phenomena of disease resistance, the study of the effect of environmental factors, and the breeding of resistant varieties, form the best avenues for approaching these problems. In essential principles the work has more in common with that done among human beings on public health and eugenics than with curative medicine. The ultimate aim should be the avoidance of disease.

"(2) Professor V. H. Blackman, Professor of Plant Physiology and Pathology in the Imperial College of Science and Technology, with reference to the training problem:

I come now to the question of the physiological aspects. Disease is abnormal physiology, so the physiological outlook is a very necessary one, and I am glad to see that the importance of this aspect has been stressed by both Dr. Russell and Mr. Chittenden. It has long been recognized that the environmental conditions have a marked influence on infection; this they do by affecting the physiological reactions of both host and parasite. The physiological conditions for infection and the physiological processes connected with it are a field of work in which our knowledge is still only just beginning. The fact that different kinds of manuring may markedly affect the degree of infection, and that changes of climatic conditions may even affect the development of a fungus already within the host, show clearly the importance of the physiological aspects of plant pathology. Another question of fundamental importance in plant pathology is that of the physiological differences between immune and susceptible hosts. Also the growing importance of what may be called plant hygiene in reducing the incidence of disease shows the importance in plant pathology of the physiological conditions of the host plant. It is clear from this that the student requires a knowledge of the outlook of modern plant physiology, and therefore some training in modern plant physiology is necessary, and this of course necessitates a grounding in physics and chemistry. No attempt should be made to make of the mycologist a competent physiologist, but such training must be given as will enable the student to appreciate the physiological outlook and to co-operate with the plant physiologist.

The training of the student should include field work even before he specializes in mycology. Ordinary botanical training with its teaching by types and its broad generalizations accentuates the similarities of plants and minimizes their differences. Field work corrects this view, to which all of us are prone owing to the psychological desire for simplification, for it brings home the marked differences, not only morphological but physiological, between one plant and another. In the actual mycological training there should be as much acquaintance with disease in the field as is practically possible.

"(3) Mr. F. J. Chittenden, Director of the Royal Horticultural Society, London, with reference to the horticultural problem:

Before mycological results can be thoroughly relied upon, the conditions that favour, as well as those that discourage, the attack of the parasite upon the host must be known, and the range of variation in susceptibility to attack must be studied. Even with the commonest disease of plants our knowledge is only partial at present, and it would tax the powers of most mycologists to the breaking point if they were called upon to say whether such and such a method of apple-growing would, with absolute certainty, avoid the incidence of even so well known a disease as the common "canker." They could more easily say what would conduce to the attack.

The special problems of the mycologist are, therefore, part only of the matter. The study of plant diseases in its entirety belongs really to the realms of the plant physiologist, and he may better call to his aid the mycologist to make a special study of the parasite, and the student of plant-relationships and plant-breeding, than that the mycologist should call in the aid of the physiologist. The physiological is the larger problem, and the mycologist should look upon his special task as a branch of the physiological problem. He should, indeed, view his task from the physiological standpoint, and base his work upon a thorough knowledge of physiology.

It is clear that even so far (and this is not all) the problem is one that calls for team work, for no one man can hope to tackle by himself all sides of the problems involved, though one man here and there may be able to co-ordinate the results of all the many lines of work that need to be followed up.

"(4) Mr. F. T. Brooks, Botany School, Cambridge:

Plant physiology is all important and I should like to spend the next five years in this study and then return to plant pathology. Equally important is field work, for this is widely different from laboratory knowledge. Only in the field can one obtain any true idea of the epidemic spread of disease, of the relative susceptibility of varieties to disease and the fact that environmental conditions often play a more important part than the actual pathogen. A tropical pathologist of acumen suggested that a necessary preliminary to mycological work was the digging of drains, and there is much to be said for this. It is essential that the mycologist should have a sympathetic attitude to the cultivator, and from his earliest stages contact with growing crops is essential. Intimate crop knowledge is imperative, for too often it is complained that the suggested remedies are worse than the disease. Treatment must be on an economic basis.

The teacher must possess a wide outlook so as to counteract the tendency to segregation of knowledge which up to a point is necessary to progress but dangerous if over-emphasized. There are bound to be the teaching aspect, the research and the advisory branches, but the teacher himself must be sufficiently broad to give the students the necessary comprehensive view-point. Often in the laboratory there is a false perspective and much time is wasted on labouring trivialities which should be spent on big problems. Only crop and field experience enable one to see things in their right proportions.

"That part of physiological study which is carried on outside of the laboratory and the greenhouse is sometimes called *field physiology* but is probably better known under the term *œcology*.

"For the purpose of indicating the conditions under which œcological work often has to be carried out in India at present, I hope you will forgive me if I refer to some personal experiences, not because I think the particular work is of any special importance but merely because it illustrates some points which I wish to emphasize.

"In 1909, I was given the problem to solve of discovering the factors responsible for the dying back of *sal* (*Shorea robusta*) seedlings and of trying to accelerate the growth of seedlings in the forest. The lines of work adopted by me were:

(1) To grow the seedlings in the experimental garden and to test the effect on their development of such factor

as the chemical and physical composition of the soil, soil moisture and light intensity; (2) to grow the seedlings under varying conditions in the natural forests, to watch their development throughout the year and to determine, if possible, by observation the particular factors which appeared to be mainly responsible for death or poor development at different seasons; (3) finally, to test the effect of the factors determined under (2) by control experiments in the experimental garden and in water cultures.

"When this work was started it was more or less novel in India, and some people were quite honestly convinced that I was wasting my time. The work was, however, carried on to a conclusion, often under considerable difficulties.

"The average forest officer is a hard-headed and very practical individual, and it often takes a long time to convince him that the results of scientific work are really of any practical value. It is, however, I think, now being recognized in the Forest Department that the results of this work really have a practical bearing of some importance on questions of the regeneration of the forests and the disease of forest trees. One of the most important results, indeed, has been that the Government of India has now definitely recognized the value of œcology in forestry by sanctioning a post for an œcologist on the staff of the botanical branch of the Dehra Dun Research Institute.

"This experience is, I think, instructive in several ways, *viz.*—

(1) It shows us that, in this kind of work in India at present, we must be prepared to face a good deal of apathy and possibly some definite opposition. The results noted above, however, are, I think, a proof that opposition is not necessarily the result of ill-will but may be the outcome of perfectly honest conviction. By patience and perseverance in such cases it is possible, in time, to persuade our official superiors that our point of view is not unreasonable and to induce them to substitute active assistance for definite opposition. In such a case, active opposition or a spirit of passive non-co-operation is useless: such antagonism merely increases antagonism in a reasonable person and can only lead to chaos. Active resistance may make a bully afraid; it will never stop an honest man doing what he believes to be right. The first lesson then is that, if we really

desire success in our search for scientific truth, close co-operation between ourselves and our official superiors who have the power of greatly facilitating and helping our work is essential.

(2) One of the first steps necessary in the work quoted above was to obtain the co-operation of our Forest Chemist, Mr. Puran Singh, for the study of the factors of the chemical and physical composition of the soil, and he gave the most loyal and strenuous help throughout, often under very heavy pressure from other work. The next step was to determine whether or not the diseased conditions observed were primarily due to fungi or bacteria. For this purpose I applied for help to Dr. E. J. Butler and Mr. C. M. Hutchinson of Pusa. This help was given immediately and generously, and without this help the work in question would probably have been impossible. The results obtained, therefore, have been primarily due to the kindness and co-operation of other scientists. The second lesson, therefore, is that, for questions of this sort dealing with certain forms of disease, the close co-operation of a number of different scientists is essential, and further that this co-operation depends rather on mutual goodwill and a desire to further the search for scientific truth than on any schemes of official control.

(3) The third point is that, if the full advantages of scientific work are to be secured, scientists must be in the closest possible touch with practical foresters and agriculturists in order that the latter may really be convinced that science is of value to them and ought to be encouraged. This fact is recognized in the Forest Department by giving selected officers a training both in forestry and some specialized branch of science. Such men form an indispensable link in the chain uniting the pure scientist to the practical forester.

"In the immediate future a good deal of the œcological work in the Forest Department will probably be directed to the study of certain serious tree diseases, such as the root disease of *sal* caused by *Polyporus Shoreæ*, the root disease of *sissoo* (*Dalbergia Sissoo*) believed to be due to *Fomes lucidus* (Leys.) Cooke, and others with special reference to the effect of environmental factors on: (*a*) the health and power of resistance of the plant, and (*b*) the

development and vigour of the parasitic organism believed to be concerned.

"As regards the *sal* disease, we are at present enjoying the co-operation of Dr. Shaw and the Assistant to the Forest Botanist, Mr. Abdul Hafiz Khan, and we hope shortly to obtain the help of a soil chemist and a biological chemist.

"It will be seen that the primary principle emphasized in this short paper is the absolute necessity for co-operation in our work on disease—the necessity for such co-operation being voluntary if it is to be really effective—the necessity for it to be the result of persuasion and goodwill rather than of coercion.

"It is believed that non-realization of this great principle lies at the base of much of the trouble, industrial and political, which at present distresses India. Is it too much to hope that, if we as scientists give the fullest possible expression to this principle in our own work, we may perhaps be leading the way in indicating the much wished-for solution of our many troubles, that we, as professional plant healers, may be taking the lead in ameliorating the present sickness of the country for which we are all working?"

The Chairman thanked Mr. Hole for his interesting address on the subject of physiology of disease, and said that he had placed this subject first on the agenda in the hope that it might give them a profitable view-point from which to make the survey of crop diseases. He proposed that they should consider those conditions of climate and of soil or those inherent in the organisms concerned which enable the parasite to live at the expense of the host. In all cases of disease they should ask themselves at an early stage in the investigation whether the crop affected was growing under healthy conditions or whether there were factors in its habit which rendered it an easy prey to the parasite. It might, for example, be possible to modify existing cultural methods so as to improve the general health of the crop and reduce the depredations of the parasite to a relatively negligible amount. An interesting problem in physiological pathology was furnished by some of the permanent experimental plots in Pusa. In certain of those plots pigeon-pea had been grown under the same manurial treatment for years past. Pigeon-pea, as they all knew, suffered from one of the wilt diseases due to a *Fusarium*. It had been observed in the last few years that the incidence of the wilt disease varied greatly in the different plots. In fact, in some plots there was nearly three times as much wilt as in others. At present the indication was that the disease was worst in those plots which have been manured with superphosphate. At all events the incidence of the disease was evidently bound up with the manurial treatment, and what-

ever the final explanation might be it must be one of deep physiological significance. The case served to show that permanent experiments if kept on long enough usually give some result—not perhaps that which they were intended to elucidate.

Again conditions of temperature and humidity played an important part, in fact almost a decisive part, in determining the success or failure of a parasite to infect a host. Thus temperature was the limiting factor in the infection of *jowar* (*Andropogon Sorghum*) by the spores of the smut fungus (*Sphacelotheca Sorghi* (Lk.) Clinton), about which they hoped to hear more from Mr. Kulkarni, and the relative scarcity of the potato blight in the plains of India was due to the fact that the causal organism could not survive under the temperatures which generally prevailed in the plains. That the limits of humidity within which certain fungi could infect their hosts were relatively narrow had been shown to be the case for a few fungi in the temperate zones, and it seemed likely that the same thing might be true for some parasites in India. Experience with *Diplodia Corchori* Syd. on jute pointed that way, and the matter was one to which they might pay more attention when carrying out infections. In the black thread disease of rubber the conditions of humidity resulting in the interior of an estate too thickly planted were partly responsible for the prevalence of the disease.

Of course while dwelling on the importance of what might be termed the external condition factor, he was not contending that all diseases could be cured by an improved culture of the host plant. There were many virulent parasites, especially in the case of highly specialized and intensively cultivated crops, which could only be met by direct intervention against the fungus such as spraying. But in such cases they might profitably pay attention to the varying intensity of the disease from year to year in correlation with the conditions of climate and culture in different seasons. Thus the humidity at certain periods of the year was the determining factor, in some parts of India, of the intensity of rust. It was necessary, however, to remember that both parasite and host might be affected in a manner favourable to the fungus. Thus in 1917 in Pusa they had a period of relatively high humidity in September-October and there was an exceptional outbreak of *Diplodia Corchori* Syd. In that case the high humidity probably favoured the fungus directly and certainly helped indirectly by delaying the ripening of the crop.

The exact evaluation of the factors which contribute to make a disease epidemic in certain years was a task of great difficulty, for not only were they faced with the varying reaction of both

parasite and host to the environment but they must undoubtedly consider the possibility of there being variations in the innate virulence of the parasite. Perhaps human diseases were the best instances of this last factor although the history of hollyhock rust and carnation rust furnished excellent examples from phytopathology. Parallel with variations in the innate virulence of the fungus there was the factor of resistance in the host and all that was implied in modern phytopathology by the word immunity—a subject on which he hoped that they might now have the advantage of hearing Mr. Howard's views and experience.

Mr. Howard said he was exceedingly interested to see that the widening of what may be described as conventional mycology was being discussed at Pusa for the first time. He felt sure that in the present phase of the subject, in any disease of plants, whether caused by fungi or by insects, any apparent conclusions reached as to the cause of disease should not be regarded as final but rather as the starting point of further investigations. He quoted the case of wheat rust as an example. For the last sixteen years he had studied many elementary species of wheat, over a period of years, he had seen many rust epidemics and had made careful observations on the susceptibility of the various pure lines to the three common rusts. During the period covered by that work he had been more and more impressed by the fact that the observations were made on half the plant—the portion above the ground—while nothing was done to find out what was the condition of the other half—the root system—both before and during the actual epidemic. That led him to reflect on the fact that the observations of the mycologist in epidemics mostly began when the disease was well established and did not take into account the previous history of the crop. Rust epidemics took place mostly in January and February. The wheat crop, however, was sown the previous October, and the preparation of the land often began during the last hot weather. He suggested that in the study of the rust epidemics all the factors influencing the root development of the wheat crop should receive just as much study as the fungus itself. A certain amount of preliminary work had been done already in the Botanical Section on these lines. An examination of the root system of varieties threw light on such questions as susceptibility and immunity. The previous treatment of the land influenced the severity of a rust attack. The amount of rust on any wheat variety varied according to whether the plant was growing in a flower pot or in the field. Sufficient results had been obtained to justify the suggestion that a mycologist in studying any disease should regard the matter from the widest possible point of view. Disease studies should embrace physiology, the effect of the growth

factors, the various varieties of any crop, as well as its agriculture. There should be no limit set to such investigations but they should be pursued in any direction likely to lead to useful results. In this way, mycological studies would become of great practical use and might easily throw light on many problems of agriculture at present imperfectly understood. A few investigations on these lines would be the most effective reply to the criticisms often expressed by practical men that mycological investigations are of little value. Economic botany some years ago in India had to overcome similar criticisms. To meet them he determined to grow the various crops, to study agriculture and to deal with the cultivator on his own ground. Although the growing of crops to perfection under Pusa conditions proved to be a laborious undertaking, he did not regret the time spent on the agricultural side of economic botany. There was no reason why mycology should not extend its boundaries in a similar manner and widen the investigations as much as possible. He did not mean to imply in the very least that the work of the mycologist was unnecessary. He wished to see it continued and greatly extended, and suggested that a study of disease in its widest sense would prove more profitable than adding to the number of diseases. In studying disease he suggested that all the factors on which growth depended should be considered, and that particular attention should be paid to the development of the root system from the seedling stage.

As an example of the influence of temperature on the incidence of disease, Mr. Sundararaman cited the case of potato blight which was never found in the Nilgiris in spite of the fact that seed potatoes had been imported from Darjeeling where the disease was prevalent. Possibly the heat which generally prevailed in the districts through which the potatoes had to pass from Darjeeling to the Nilgiris was the cause of this.

In reply to Mr. Dastur's enquiry Mr. Sundararaman said that he did not know at what time of the year seed potatoes were imported from Darjeeling for sowing in the Nilgiris. *Piricularia* on rice was found to be very virulent in fields green-manured with *dhaincha* (*Sesbania aculeata* var. *canaabina*) where the crop was well grown, while poorly grown plants were completely free from disease. In 1918 the humidity was very high and the disease was very severe, while 1919 was a very dry year and the disease was completely checked. As regards the coconut bud-rot the inoculation experiments showed that the identical field symptoms which could be produced in Malabar could not be obtained in Coimbatore.

Mr. Kulkarni said that in Bombay experience had shown that attempts should be made to study pathological problems on a

physiological basis. He cited the case of a *Citrus* plantation which remained healthy for five years. The plants then began to suffer from wither tip. The usual remedies such as cutting the diseased twigs and spraying the plants were carried out but the disease was not checked. The soil conditions were then studied and it was found that in the subsoil there was a layer impervious to water. The drainage of the field was improved and trenches were dug. In two years' time the plants improved considerably.

In southern parts of Surat (Gujarat), red rot of sugarcane was very prevalent. Selection of setts and introduction of new varieties were not successful. In these districts, owing to the proximity of the sea, during the high water tide and during floods sea water mixed with the river water, and therefore the flooded fields became very saline. He was therefore inclined to believe that a predisposing factor for red rot was the salinity of the flooded fields.

Mr. Howard suggested another explanation. If the floods were high there would be very little motion of soil water, and it was probable that apart from the presence of salt in the soil the immobility of the subsoil water would affect the root system of the plants and prevent development of root hairs. And therefore the plants might become more susceptible to red rot. Mr. Howard considered that a study of the soil conditions and development of the roots might throw light on the whole problem.

Mr. Kulkarni said that grain smut of *jowar* was very common in the Central Provinces, Bombay, Burma and Madras, but it was not common in the Indo-Gangetic plains. From the study of the germination of the spores it appeared that the infection was most likely to succeed at moderate temperatures between 16° to 30°C. The spores between these temperatures germinated freely, while the growth of the *jowar* seedlings was retarded so that the susceptibility stage was prolonged. Infected *jowar* seeds sown in flower pots were germinated at 25°C. and 40°C., and were planted out when they were four days old. Plants from seeds germinated at 25°C. were smutted, while those from seeds germinated at 40°C. were free from the disease. Smut-infected seeds sown at Pusa and Larkana gave smutted plants, while those sown at Jacobabad gave a healthy crop.

Mr. Mudaliyar said that in Baghdad some of Professor Biffen's rust-resistant varieties of wheat became badly rusted. He was informed that in Persia where the temperature was not so high as in Baghdad the plants became more rusted. Sore shin of cotton was very bad in 1919, but in 1920 the temperature was not so low as in 1919 and the summer commenced earlier and therefore there was no occurrence of sore shin.

Mr. Padmanabha Pillai said that in Travancore *Helminthosporium* was a serious disease of coconuts. It was prevalent in the backwater tracts of Travancore but was not so much in the inner and drier parts. He thought that it was a mistake to say that humidity was absolutely necessary for all diseases. He had observed, for example, the stem bleeding disease of coconuts more in drier parts than in wet parts.

Mr. Hole said that *sal* seedlings were more susceptible to disease both in very wet and in very dry weather.

The Chairman said that in Kumaon apple mildew spread most rapidly in May when the weather was relatively warm and dry.

Mr. Howard agreed that humidity was not the only factor and other points had also to be considered in the prevalence of disease.

Mr. Pillai pointed out that straggling seedlings of coconuts were not affected while well growing seedlings were badly attacked by *Helminthosporium*.

Mr. Dey said that the effect of certain conditions on the health of a plant was well noticed at Gorakhpur farm where sugarcane growing in that part of the field which was exposed to sun and wind was badly attacked by red rot, while the crop in the shaded part was comparatively free from the disease.

The Chairman said that in Jammu it had been recently found that the red rot of sugarcane was more prevalent in fields which were excessively irrigated.

With reference to Mr. Dey's observations, Mr. Kulkarni said that it was possible that in the beginning the conditions were favourable for red rot. The standing crop of dead plants sporulated very freely and so the spores might have been carried by the wind and infected healthy plants.

Mr. Sundararaman said that the *Vermicularia* disease of ginger was more prevalent in exposed fields than in shaded fields.

Mr. Dastur said that he had a similar experience with the chilli die-back. Plants growing in the shade of wayside trees were found to be healthy, while those growing away from the shade of those trees were badly attacked. The disease was very virulent in 1917. That year there was rain in the end of September and in the first week of October at the time when the plants were beginning to flower. In 1918, 1919 and 1920, the die-back was either negligible or completely absent at least in the north of the Ganges because the rainfall was very deficient in those years, and at the time of flowering there was no rain and the days were warm and sunny and the nights clear and dry. In 1917 for the first time there was an outbreak of *Choanephora cucurbitarum* on

chillies when this fungus did considerable damage to the crop; but it had not been seen since. The last case was an interesting example of a sporadic outbreak of a new disease. Such an outbreak must have been conditioned by a combination of factors not normally operating.

Mr. Hole said that *sal* seedlings when exposed to side shade badly suffered from attack of fungi like *Cercospora* but not when exposed to over-head shade; the explanation was that plants exposed to side shade got all the dew at night and remained continually wet and damp throughout the day but over-head shade had not these deleterious effects, even though it was darker than side shade.

Mr. Sundararaman said that in paddy fields plants growing in the shade of trees were found to be badly blasted.

The Chairman pointed out that in case of epidemics one had as a general rule more or less to rely on memory as to conditions prevalent before the epidemic was noticed. Yet the climatic conditions in the period immediately preceding a virulent outbreak of disease must be just those which had most contributed to the establishment of the epidemic. The examples quoted were very interesting and he was sure that still more valuable results could be obtained by a careful and continuous record of weather conditions. It would probably be necessary to make determinations by instruments actually situated in the midst of the crop.

Mr. Pillai was of opinion that a study of œcology would be of material help in solving pathological problems. He cited the case of cardamoms and ginger which thrived better in shade and therefore became more susceptible to disease in exposed fields.

Mr. Dey said that the breaking down of resistance to disease was a physiological problem. He was told that resistant varieties of sugarcane tried at the Coimbatore Sugarcane Breeding Station became susceptible to red rot when continuously vegetatively propagated for some years. Potatoes and other vegetatively propagated crops also showed the same breaking down of resistance.

Mr. Howard said that potato growers round about London, Lancashire and Leicestershire had continuously to import seed potatoes from Scotland. In the plains of Java, sugarcane had to be brought down from the hills. It was a problem worth investigating why continuously vegetatively propagated crops should do well in certain localities and get diseased in certain localities. It was probable that the substances formed at various stages in the ripening of the plant were different in degree in different localities and certain substances might be formed only under certain condi-

tions. In seed-forming plants a change of seed was found to be necessary in certain localities where the crop could otherwise be grown to perfection, except for seed.

Mr. Pearl said that the very natural tendency was to go for the obvious. The mycologist was naturally interested in the fungus and therefore he devoted much attention to the study of the fungus itself, but the plant was perhaps neglected. It was important to study the condition of the roots in relation to their susceptibility to disease, and it had been suggested to him that in its native home *Hevea* may have symbiotic relation with mycorrhiza which were lacking in those countries to which it had been introduced.

The Chairman, in concluding, said that he hoped that on the survey of plant diseases the physiological aspect of disease would not be neglected. Those who were interested in diseases of rubber would do well to bear in mind the suggestion that the fungus which was normally present in the mycorrhiza of the roots of *Hevea brasiliensis* in its native home might be absent in the countries to which *Hevea* had since been introduced. In that case it was possible that some other fungus was functioning as mycorrhiza in their new countries, and the numerous ills of the rubber plantation might be traced to the fact that the fungal partners in the mycorrhiza of *Hevea brasiliensis* was not in perfect tune with the host.

Mr. Howard said that this meant in a word that the introduction of *Hevea brasiliensis* to new countries had perhaps not been complete.

The meeting then proceeded to consider—

Subject II.—Survey of diseases of crops.

The Chairman said that at this meeting they could not hope to deal very fully with this subject but there would no doubt be a certain amount of information new since the last meeting, and they would begin with a discussion on cereal diseases.

Wheat.

Mr. Sundararaman said that there were only two diseases of wheat in Madras, *viz.*, rust and *Piricularia*, both of which did not do much damage.

Mr. Kulkarni said that the chief trouble in Bombay was foot rot due to *Fusarium*. In reply to Mr. Dastur's enquiry Mr. Kulkarni said that the grains showed different symptoms of infection according to the time when they became infected.

Mr. Pearl said that foot rot of wheat was serious in the Central Provinces, especially in Seoni Malva and Hoshangabad, both on the stem and on the ear.

The Chairman drew the attention of the meeting to a new mode of treating bunted seeds with copper carbonate found by Darnell Smith of Australia (vide *Science and Industry*, Vol. I, No. 8, 1919, p. 455).

Oats.

Mr. Sundararaman said that in the Nilgiris the chief diseases of oats were *Ustilago Avenæ* (Pers.) Jens. and a leaf spot caused by *Rhynchosporium*. In reply to the Chairman's enquiry Mr. Sundararaman said that no treatment was carried out for the oat smut.

Mr. Dey remarked that in Dehra Dun about 30 per cent. of the oats were damaged by smut.

Jowar.

Mr. Kulkarni said that the smuts of *jowar* and their treatment were fully described in Bulletin No. 78 of the Agricultural Research Institute, Pusa. The copper sulphate treatment was carried out on a large scale by the general public and co-operative societies. One interesting point about the treatment was that seeds pickled in copper sulphate did not become reinfected even if they came in contact with smut spores. The reason was that copper sulphate solution completely permeated the mucilaginous covering on the seed coat and therefore the dried seed was protected by a coat of the poison. This protection against reinfection was of great advantage because it excluded the necessity of sterilizing drying floors and sacks.

Mr. Sundararaman said that the treatment of *jowar* seed was also carried out in Madras. As information regarding the treatment was very often given in the monthly Agricultural Calendar of the department this treatment was followed even in the remote districts of the province. Every year the agricultural staff distributed packets of copper sulphate and in new tracts demonstrations as to its use were given. For the smut on *Setaria italica* the same treatment was followed. Another severe disease was the sugary disease.

The Chairman enquired if treatment against *jowar* smut was being carried on in the Central Provinces.

Mr. Ajrekar stated that the treatment in the Central Provinces was very crude. In some of the farms copper sulphate powder was rubbed on the seeds.

The Chairman enquired if any further information since the last meeting was available regarding the *khas* disease of *jowar* in Sind.

Mr. Ajrekar said that as this disease proved on investigation to be caused by an insect it was being studied by the entomological section.

Mr. Dey said that in the United Provinces there was a great deal of *jowar* smut and *Colletotrichum graminicolum* (Ces.) Wils. Rust was also very severe.

Mr. Narasimhan remarked that the chief trouble of *jowar* in Mysore was *Striga*. Experiments in spraying with various strengths of iron sulphate solution were tried with the result that young *Striga* seedlings were killed.

The Chairman said that *Striga* was fairly common in the Central Provinces, Bombay and Burma. The above-ground portion of the parasite could be killed by spraying but the rhizomes could not be so killed and new shoots were produced in large numbers.

Barley. Mr. Mitra said that this year, at Pusa, Cape barley was very badly attacked by the stripe disease caused by *Helminthosporium gramineum* Rabenh. Other cereals were also attacked by different species of *Helminthosporium*, and cross-inoculations from barley to wheat, *jowar*, maize, rice and sugarcane and *vice versâ* had been successful.

Maize. The Chairman said that in his capacity as Secretary of the last meeting he had sent the following excerpt from the minutes to Mr. Whetzel, Chairman, War Emergency Board, United States of America :—

Mr. Ajrekar said that with regard to diseases of maize, out of 30 maize plants raised from seeds got from America, 20 were infected with *Sclerospora* which he thought was the same as studied by Dr. Butler in Pusa, *viz.*, *Sclerospora Maydis* (Rac.) Butl. He suggested that this disease must have been carried through the seeds.

Dr. Butler observed that *Sclerospora Maydis* (Rac.) Butl. was not known in America. It was reported from Java and possibly occurred in the Philippines. He remarked that the fact that the plants from the American seed were affected by *Sclerospora* should be reported to the War Emergency Board. It was not at present serious in India but there had been a few bad attacks, and the appearance of the disease in Bombay was important.

He received the following reply from Mr. Whetzel :—

I am very glad to have the information therein contained in your letter particularly that on the diseased maize plants which were raised from American grown seed. I very much doubt that the fungus was carried through the seed, for this fungus is not known in this country although we have been on the look for it during the last few years. You will doubtless receive a request for more detailed information about the origin of this seed, for I am bringing it to the attention of our cereal pathologist, Dr. H. B. Humphrey of Washington, D.C.

Mr. Ajrekar said that at the request of Dr. Shaw he had sent to Dr. V. H. Watson, College of Agriculture, Los Banos, Laguna, Philippine Islands, the following information regarding the occurrence of *Sclerospora Maydis* in 1918 at Poona :—

1. The fungus appeared on the majority of about a hundred plants grown from American imported seed for purpose of practical work in connection with the plant-breeding class at the Poona Agricultural College.

2. The seed was supplied by a local firm who had imported it from America under the name of " Cory's Early Sweet " variety in 1917.

3. The firms in America which supplied this seed are stated by the local firm to be :—

i. Peterson Henderson and Company, 33-35, Cortlandt Street, New York.

ii. James Vick's Sons, Rochester, New York, United States of America.

4. The seed was sown on 22nd June, 1918, and the *Sclerospora* was noticed on the plants when about four weeks old. Only the conidial form had appeared and it agreed with Dr. Butler's description of *Sclerospora Maydis* (Rac.) Butl. in *Memoirs of the Department of Agriculture in India, Bot. Series*, Vol. V, No. 5.

5. Another American variety—"American Field Variety"—supplied by the same firm and grown with Cory's Early Sweet did not show the disease at all.

6. This was the first occasion that *Sclerospora* was observed on maize in the Bombay Presidency. Hence the suspicion that it was conveyed probably with the seed.

In reply Mr. Weston wrote :—

Your report of the appearance at Poona of the *Sclerospora* on corn which was grown from American seed aroused great interest here, and I want to thank you for your co-operation in sending this information to us.

In the Philippines I found that the wild grass *Saccharum spontaneum* Linn. serves as a host for the downy mildew which passes from this grass to cultivated maize. This *Sclerospora* in its conidial stage is not conspicuous on the wild *Saccharum*, nor does it destroy the plant, but rather the infected clumps of grass live on comparatively uninjured and spread the disease widely through producing conidia over many months. In inoculation experiments I was also able to infect *Miscanthus Japonicus* with the conidial stage of the *Sclerospora*, but I never found this grass infected in its native habitat. Teosinte (*Euchlæna* spp.), sorghum (*Andropogon Sorghum*), and sugarcane were also found to be infected occasionally with the conidial stage. From these facts I feel sure that *Saccharum spontaneum* Linn. is to be regarded with suspicion in India, and if this grass is common in Bombay I would suspect that it might be harbouring disease there also and transmitting it to such susceptible and weakened maize plants as those produced by introduced and unacclimatized seed.

In any case, the fact that the disease appeared in your Cory's Early Sweet plots when the plants were about four weeks old indicates that they were infected from some source in the region, for when plants are attacked early in their development, as would be expected if the disease were brought in with the seed, they show the effect in from five to ten days, and it does not seem probable that in the case of your plants seed infection would have delayed so long in showing itself.

The fact that the American Field Variety planted at the same time did not show the disease was probably due to local conditions. The conidia are produced at night and spread by night breezes and the infection or non-infection of any plot depends on the location of the plot in relation to night wind, in relation to the position of infecting corn or grass plants, and in relation to the protection afforded by local windbreaks.

At the College of Agriculture of the Philippines there is frequently noticed the same occurrence which attracted your attention at Poona. In a trial plot of Early Mayflower sweet corn grown at the college from seed imported from the United States, every single plant became infected with downy mildew and almost all were killed as is shown in photograph 940. This was due not to the fact that the disease had been brought in with the seed, but that one infected corn plant had escaped notice in the plot at the right and had on successive nights infected the new planting of this susceptible, weak and unacclimatized variety.

May I suggest therefore that the appearance of the downy mildew in Poona may be traced to *Sclerospora* which has escaped notice on *Saccharum spontaneum* Linn. or some other wild grass of the region ?

In addition to the conidial stage through which the immediate infection of nearby maize can take place, the wild grasses of the Philippines were also found to harbour the oogonial stages of *Sclerospora*. Not only *Saccharum spontaneum* Linn. but also *Miscanthus Japonicus* and a red-stemmed primitive sugarcane are frequently badly attacked by oogonial *Sclerospora*, especially in the higher elevations.

The Chairman enquired if in the light of this information there was any possibility of the infection being local.

Mr. Ajrekar was of opinion that local infection was impossible.

Mr. Kulkarni said that last year varieties of maize were received from the Director of Agriculture, Kashmir, and three varieties, *viz.*, Amba Pearl Corn, White Rice Pop Corn and Mockory Field Corn developed *Sclerospora*. In reply to his enquiry as to when and

from where those varieties were introduced, the Director informed him that these varieties of maize were received from New York in 1909 and 1910. It was therefore not possible to trace the origin of the disease.

Mr. Subramanium remarked that at Pusa mycelium had been found in the seeds of infected plants.

Mr. Dastur enquired if the *Sclerospora* at Poona was really *Sclerospora Maydis* (Rac.) Butl. and not one of the other three known on maize.

Mr. Ajrekar replied that a critical study was not made.

The Chairman said that some ten years ago he had described *Physoderma Zea Maydis* Shaw on maize from Assam. In America two or three years ago a serious disease of corn was attributed to this *Physoderma*. As far as he knew it did not do appreciable damage in Assam. The disease seemed to be indigenous in Central America on *Euchlæna mexicana* and it was possible that it reached America on this host. He suggested that they should be on the look out for an extension of this disease.

Rice. Referring to the diseases of rice Mr. Sundararaman said that the most important disease in Madras was paddy blast caused by *Piricularia Oryzæ* Cavi. Cross-inoculations from rice to oats, *ragi* (*Eleusine coracana*) and wheat and *vice versâ* had been successful. This disease was very sporadic in its virulence. Steeping blasted seedlings in one per cent. copper sulphate at the time of transplanting was found to kill the blast.

Md. Taslim said that rice seedlings had been found to be badly blasted in the neighbourhood of Pusa but that the disease completely disappeared after the seedlings were transplanted.

Mr. Sundararaman said an eelworm disease different from ufra was found in Madras and was being investigated by the entomologist.

Mr. Kar said that in Bengal ufra was not serious last year. The cultivators took a keen interest in burning the stubble, a process which had proved very beneficial.

Mr. Kulkarni said that in 1919 in the Thana District of Bombay a thousand acres of rice were badly damaged by *Sclerotium Oryzæ* Catt.

Mr. Mitra remarked that at Pusa there was a common leaf spot. The fungus had so far remained sterile both in cultures and on the host leaves.

Sawan. Mr. Kulkarni said that *Ustilago paradoxa* Syd. and Butl., the smut of *Panicum frumentaceum*, was common in Bombay and was amenable to copper sulphate treatment.

Mr. Bose said that in Assam he had found *Hymenochæte noxia* Berk. and *Rosellinia* on *rahar* (*Cajanus indicus*).

SECOND DAY.

The discussion on Subject II was continued.

Potato. Mr. Kulkarni said that in Bombay potatoes suffered from a leaf curl the cause of which was found to be a mite. The disease could be controlled by spraying with lime sulphur. As the cultivators found it difficult to do the spraying efficiently it was done by the Union Agency Limited. A paper on this mite disease of potatoes was read at the last Indian Science Congress, and a bulletin had been published describing the disease. Another important disease was due to *Fusarium* which caused wilting of the plants and a black ring in the tubers. The incidence of this disease was dependent on temperature. High temperature favoured the disease. Even infected seeds gave a healthy crop if at the time of sowing the temperature was low. Last year potatoes from Italy arrived very late and were sown in the end of January, and the resulting crop was badly diseased. Rigid selection gave excellent results. As the infection took place through the stem, every stem end was removed and tubers showing any brown or black marks were rejected. If the seeds were planted in winter this fungus gave no trouble.

With regard to the black rot of stored potatoes it was found that tubers stored at 40°C. developed black rot, but those stored at 27°C., in chambers with double walls, were very little affected. In Italian potatoes the blackening was different from that in the North Indian varieties. In the Italian variety the blackening was throughout the tuber, while in the North Indian varieties the blackening was in the heart of the tuber. Italian potatoes when stored at high temperature developed heart rot and sometimes also *Rhizoctonia*, but in the North Indian varieties heart rot at high temperature was not associated with any fungus.

The Chairman said that in the Punjab the chief factor in the storage rot of potatoes was high temperature. Storage at relatively cool temperatures lessened the rot. The storage rot of potatoes when they were stored in sacks was from 60 to 70 per cent., while the rot of potatoes left exposed to air on wooden racks was only 15 to 25 per cent.

Mr. Kulkarni said that in the case of early blight it was found that manured fields gave as good a crop as sprayed fields and therefore manuring was preferred to spraying.

Chilli. Referring to chillis Mr. Kulkarni said that in Bombay *Oidiopsis taurica* (Lév.) Salm., *Vermicularia Capsici* Syd. and leaf curl were the chief diseases. The leaf curl was controlled by a lime-sulphur wash.

Mr. Kar said that at Faridpur three sprayings of one per cent. Blighty Burgundy mixture was found to be effective against die-back.

Mr. Dastur said that the spraying experiments at Pusa against die-back for the last two years had not given any results because this disease had not appeared in the fields on account of deficiency of rain and high humidity at the flowering period.

Castor. As regards castor Mr. Dastur enquired if the *Botrytis* disease of the beans occurred in any of the provinces as he had received enquiries from Mr. Godfrey, Pathologist, United States Department of Agriculture, who had observed this disease on plants raised from beans sent from Bombay; he had found the perfect stage of the fungus.

Mr. Narasimhan replied that this disease was in Mysore and that he had also found the *Sclerotinia* stage.

Tobacco. The Chairman enquired whether there was any information with regard to the incidence of leaf spot (*Cercospora Nicotianæ*) on tobacco.

Mr. Ajrekar remarked that in Gujarat *Erysiphe* was doing some damage.

Mr. Sane said that in Baroda tobacco plants were often found dying off in patches in the fields.

The Chairman remarked that the cause of this might be *Rhizoctonia, Fusarium* or bacteria.

Mr. Ajrekar said that he found all these three pathogenes in the specimens he had examined but *Fusarium* was the most common.

Poppy. Mr. Dey said that the chief trouble of poppy in the United Provinces was *Peronospora arborescens* (Berk.) de B.; the predisposing factor for this disease was the local method of storing the seeds. It had been found that storage of seed in earthen pots did not allow of proper aeration and the seeds thus stored gave a diseased crop. The disease was considerably reduced when the crop was raised from seeds stored in a way which allowed of free aeration. Mr. Leake had found a new variety which was resistant to *Peronospora arborescens*.

Tomato. Mr. Kar reported that a bacterial disease was very bad on tomatoes in the red soil of Dacca.

Mr. Ajrekar said that in Bombay *Cladosporium fulvum* Cke. was the cause of slight damage to tomatoes.

Mr. Pillai said that *Didymella* did considerable damage to car- Cardamom.
damoms; both Mysore and Malabar varieties were susceptible. It caused spotting of the leaves and rot of rhizomes. It was also found on leaves and pods of *Erythrina*.

Mr. Ajrekar remarked that this Travancore disease was different from that in Bombay, locally known as "katti." The Agricultural Chemist had found that heating of the soil completely checked this disease.

Mr. Ajrekar said that he had isolated a *Fusarium* causing Cotton.
cotton wilt in the Central Provinces. He had established the parasitism of this fungus. This same fungus he had also got in cultures from wilted plants in Bombay. He had obtained two strains which were identical in all respects except that one produced colour and the other did not in the sclerotial bodies. He had grown the fungus on complete Czapeck's solution and on similar solutions in which from each medium some one essential element, such as potassium, nitrogen or phosphorus, was lacking. The fungus grew best on the complete medium, fairly well on the one lacking in potash, but poorly on those which did not contain nitrogen and phosphoric acid. The fungus was found to be particularly sensitive to nitrogen and phosphoric acid. It did not grow in soil solutions taken from the permanent experimental plots of Nagpur farm which had received the same artificial fertilizers for the last 10 years and in solution of soil from plots which had received organic manures. Further work on this fungus was being continued. Buri cotton was perfectly immune not only against field infections but also against artificial infections, but on plant juices from this immune variety and the susceptible *roseum* the fungus grew very well.

The Chairman suggested that in view of the experience with the wilt of pigeon-pea in the permanent experiments at Pusa, which had been mentioned in the discussion on physiology of disease, the effect of different amounts of phosphoric acid on the fungus should be investigated.

Mr. Kulkarni said that the exotic varieties, Buri, Dharwar-American, Upland Georgian and Cambodia, were wilt resistant, according to the report of the Cotton Supervisor and Deputy Directors of Agriculture.

Mr. Dey said that in the United Provinces considerable loss was caused by the shedding of bolls. This trouble appeared to be dependent on physiological conditions and was not due to a parasite.

Mr. Sane wished to know the cause of cotton plants dying oft in patches in Baroda; in course of time the field had scattered bare areas.

The Chairman suggested that the trouble in Baroda may be the same as in the Punjab where Dr. Butler had found that the dying off of cotton plants was due to local variations in the soil associated with a hard pan below the surface soil.

Mr. Hole said that Dr. Russell of Rothamsted Experimental Station had in his survey of the soils of England found patches of good, indifferent and poor crops; he showed that the difference in cropping was due to the variations of chemical constituents of the soil.

Dr. Dudgeon said that in the irrigated areas of West America excessive nitrogen occurred and crops grew very well up to the edge of those areas but within those areas the crops died out.

Sugarcane. The Chairman requested Mr. Mitra to give an account of red rot of sugarcane in Jammu.

Mr. Mitra said that in the canal-irrigated fields where irrigation was excessive about 90 per cent. of cane suffered from red rot, while there was much less disease in fields where the irrigation from wells was more scanty. The ratoon crop was chiefly affected. The disease was on the increase during the last 4 or 5 years. Thin varieties were very little affected.

Mr. Ajrekar said that in Amalsad district of Gujarat the salinity of irrigation water was found to be the predisposing factor for the incidence of red rot.

Mr. Sundararaman said that on three occasions varieties imported from Hawaii, Demerara, and Java by the Sugarcane Breeding Station at Coimbatore were found to be attacked by the pine apple disease. These varieties, however, had been destroyed before sowing and the disease had never existed in fields in Coimbatore.

Palms. The Chairman said that recently a foot rot and bud rot were found on areca palms in Sylhet and Bengal. The foot rot was perhaps due to *Thielaviopsis*.

Mr. Ajrekar said that areca palms in Bombay suffered from a bleeding disease. A reddish fluid exuded from small holes about two feet above ground level. This was associated with a *Fomes*.

Mr. Narasimhan said that *Thielaviopsis* on the areca palm was known in Mysore, but there were no bleeding symptoms as in coconuts. A *Fomes* was also found.

Mr. Sundararaman said that *Colletotrichum* and *Glœosporium* attacked seedlings in nurseries.

Mr. Kulkarni said that in July and August when the humidity was very high there was splitting of the calyx and shedding of the nuts.

The Chairman suggested that this might be similar to the splitting of apples in some orchards in India; in such cases it was very likely that the cause was physiological, due to rapid variations in humidity. It might be paralleled with the causes of some gummosis.

Mr. Pillai said that in Travancore much loss was caused by splitting of the nuts and by their premature shedding. The cracking and shedding occurred especially when the tree bore an abundant crop. The *Helminthosporium* disease of leaves was epidemic.

Mr. Sundararaman said that the bleeding disease of coconuts was successfully treated by excising the infected parts, drying the wet surface of the cavity with a lighted torch and covering the exposed parts with hot coal tar.

Mr. Pearl said that *Diplosythiella bambusina* Dietel. was collected on leaves of bamboo last year in the Central Provinces. According to Dr. Butler this fungus was first collected by him in Dehra Dun and proved to be a new genus and a new fungus; the Central Provinces collection was the second that had been made in India, and was of great interest because it had the perfect stage of the fungus on it which appeared to be a new genus belonging to the *Hypocreaceæ*. **Bamboo.**

Mr. Dey said that it was essential that there should be a correct estimate of loss caused by diseases to major crops of India. He thought that the discussion on the survey of diseases had shown that there was very little reliable information at present available. He therefore moved the following **resolution** :—

"An effort should be made by departments of Mycology to keep an annual record of the actual damage, with an estimate of the financial loss involved, done to the principal agricultural and forest crops by the major fungal diseases of the province."

Mr. Ajrekar seconded.

Mr. Pearl wished to know if any common method for the estimate of the loss could be suggested because in absence of a common method there would not be uniformity in the results.

Mr. Hole strongly supported the resolution and said that it was not possible to fix any particular method; the worker must have full discretion in adopting any method he found convenient.

The Chairman said that to have really reliable figures the observations at first should be restricted to only a few crops in each

province. He doubted whether the mycological staff in any province would be able to tackle more than one crop.

Mr. Sane suggested that as the monetary value of a crop was a variable factor from year to year the loss should be considered not in money but in the area involved.

Mr. Hole said that in the case of forests the loss must be estimated in its money value.

Mr. Dastur doubted if the present mycological staff of the provincial departments was large enough to undertake this work.

The motion **was carried.**

At the request of the Chairman, Major de Mello gave an account of some of the principal diseases of Portuguese India. He said that work in plant pathology was only recently started and only a few diseases had been investigated. Foot rot of *Carica papaya* was successfully treated by an application of 5 per cent. solution of copper sulphate.

The worst disease of coconut palms was what was locally called "Mumdolim" but he was sure that under the name several distinct diseases caused by insects and fungi were included.

The bleeding disease was not found on laterite soils but only on the littoral soils.

The coconuts were also attacked by a root disease which did considerable damage over a large area. The symptoms of the disease were that the leaves withered and the trees did not flower.

An eelworm disease of sugarcane had also been found. The adult eelworms had not as yet been observed but a large number of eggs and embryos in the diseased tissues had been found.

The Chairman thanked Major de Mello for his interesting account of plant diseases in Portuguese India, and said that it was for the first time that the conference had any information regarding the crop diseases of Portuguese India.

The meeting proceeded to consider—

Subject III.—Discussion on spraying.

The Chairman, in opening the discussion on spraying, said that he wished to place before the meeting the results of spraying work in orchards in Kumaun and Peshawar and to make a few observations on his visits to the manufacturers of spraying machinery in England when he was on leave. There were two classes of sprayers, one worked by engine power and the other by human agency. Of the second class, the Knapsack type which required to be worked continuously by hand was not good for India. The

pneumatic sprayers were the best but they had one serious defect. They did not give a constant uniform spray because the fineness of the spray depended upon the pressure behind it, and therefore as the pressure decreased the quality of the spray deteriorated. Of the pneumatic sprayers, the Holders were the best ; they were originally made in Germany but now they were made in England by Ubel (United Brass Foundry and Engineering Limited). Another type of hand-worked sprayer, the machinery of which could be carried on a trolly, was the Hayes hand power pump. This was the most satisfactory type of machine worked by hand. A similar type was also manufactured by Ubel. With such machines it was quite easy for one man to maintain a steady pressure of 150 lb. per square inch. Higher pressure did not give an improved spray.

In the power sprayers the motive power was supplied by steam or petrol engines, and there were two ways in which such outfits could be used. In one method the engine and reservoir were stationary and a light steel main made in sections with flexible couplings was led from the engine down the orchard which was to be sprayed. From this main side pipes led to hoses which supplied nozzles. A number of nozzles could be worked at once and a large area sprayed at one time. The method sounded cumbersome but was a great success owing to the lightness of the steel mains and the perfection of the flexible couplings. He had seen this system in operation in hop gardens in Kent. A very excellent type was made by Messrs. Merryweathers. Photographs of this installation would be shown to members.

Another type of power sprayer was the petrol engine mounted on a carriage carrying a reservoir for the spray fluid. The weakness of this type was the trouble and waste of energy involved in moving a large quantity of liquid about the orchard. A new system of power spraying had been worked out in England by Mr. Lefroy. In this system the power from a petrol engine was used to pump air into a pneumatic sprayer already containing the fungicide. The pneumatic sprayer was of the usual Holder type and was carried on the back. A number of sprayers could be worked from one engine as a battery outfit. This system had the advantage that it could also be used for dusting as the sprayers could simply be charged up with air and a dusting attachment substituted for the ordinary lance and nozzle.

Spraying of peaches against leaf curl in Peshawar and Kumaun had been carried out successfully for some years. A striking example of the success of the spraying was noticed once in an orchard in Kumaun where through an oversight two or three trees in one

corner were not sprayed with the result that they were the only trees in that orchard that had the leaf curl that year. In 1919 a test of the Holder sprayer against the Hayes hand power pump was made at Peshawar. The Hayes type was found to be superior. It was found that this sprayer with 5 men in 19 hours sprayed 206 plants and used 708 gallons of Burgundy mixture, while two Holder sprayers worked by 4 men for the same number of hours sprayed only 54 trees and used 492 gallons of the fluid. For this test the trees selected were, as far as possible, of the same size. It was evident that by using Hayes there was economy of time and of the spray liquid as well.

In Kumaun in 1919 home-made lime sulphur and Berger's lime sulphur were found to be equally efficient but Berger's was too expensive to be used on a large scale. One very important point in doing spraying experiments on fruit trees was that for any one experiment the same particular variety of apple or pear tree must be used.

An important disease in Kumaun was the mildew of apple which spread rapidly during warm dry weather. The susceptibility of different varieties of apples differed considerably. "Northern Spy" was so bad in this respect that it was being removed completely.

In 1919 lime sulphur had not proved a good spray against mildew, thus reversing their experience of the previous year, and this season they intended to try iron sulphide which had proved successful in California. With regard to the making of lime sulphur, the home-made solution according to the formula 53 lb. lime, 100 lb. sulphur, 50 gallons water usually had a density of about 24 with Beaume's hydrometer. It was useful to remember that for a solution with a density between 6 and 26, the reading of Beaume's hydrometer gave roughly the number of gallons of water which had to be added to one gallon of stock solution to make a summer strength spray. Commercial lime sulphur had a density of about 35°. It had recently been found that the addition of saponin to lime sulphur increased its spreading properties.

Mr. Pearl requested some information regarding the type of nozzle found to be most useful in practice.

The Chairman thought the best type of nozzle was the disc nozzle. The nozzle with several joints and with pins to clear the jet opening was undesirable because of the constant trouble of leakage from these joints. There was a good nozzle which was fitted with an adjustable collar by means of which either a wide angle spray or a long and narrow angle spray could be delivered.

Mr. Ajrekar said that one of the most important problems in grape culture in Bombay was the control of the fungus diseases which were mainly two, mildew (*Uncinula necator* Schwein) and anthracnose (*Glœosporium ampelophagum* (Pass.) Sacc.). In 1919 tests were made of the following remedies against mildew :—

(1) Potassium sulphide in the proportion of 4 oz. to 8 gallons water.

(2) Ammoniacal solution of copper carbonate, having the composition ammonium carbonate 1 lb., copper carbonate 5 oz., and water 40 gallons.

(3) Bordeaux mixture—normal strength (copper sulphate 5 lb., slaked lime 5 lb., soft soap 4¼ lb., water 50 gallons).

The variety of vine used was Bhokri. 22 plants received the first treatment, 38 the second and 18 the third.

The dates of spraying were as follows :—

Treatment 1.—June 21st, July 9th, July 31st, August 15th.

,, *2.*—June 21st, July 9th, July 31st.

,, *3.*—June 17th, July 9th.

Bordeaux mixture was far and away the most effective. The plants sprayed with it were free from mildew. Those sprayed with treatment 2 were next best, but showed some mildew. Those sprayed with treatment 1 (potassium sulphide) were worst. An additional spraying had to be given in August to plants under this treatment as the attack was bad.

The plants treated by Bordeaux mixture kept their leaves green and produced well ripened canes.

This experiment could not be continued in the next three months as all the plants had to be heavily treated with remedies against anthracnose, but the results were fairly conclusive.

Anthracnose appeared in June, July and August 1919, and the ordinary measures taken against mildew did not stop it. The diseased branches were removed and burnt on June 21st, July 11th, 12th, 23rd, 28th and September 1st, but the disease was not checked. The following varieties proved resistant to this disease : of the local varieties, Neelum ; of the foreign varieties Lady Downes and Brilliant.

Pruning was done on October 15th, 1919, and thereafter a vigorous action was taken against anthracnose. The bark of all vines was removed, and the vines were washed with the following mixture : Sulphuric acid 1 part, iron sulphate 8 parts, and water 100 parts, all by weight. The amount required per plant on the

single stake system was one gramme sulphuric acid, 8 grammes iron sulphate and about 135 grammes water. One man did seven trees in ten hours.

The Bhokri plants on the stake system were also sprayed with a solution of iron sulphate as above without the sulphuric acid, and the live supports of Pangara (*Erythrina indica*) also received the spray. Anthracnose, however, appeared on October 29th. The plants were then sprayed with the following mixture: Lime sulphur wash and Bordeaux mixture mixed together. Lime sulphur wash is lime 11 lb., sulphur 1 lb., and water 6 gallons. To this were added 6½ gallons Bordeaux mixture.

These 12½ gallons were considered as a stock solution which was made up to 62½ gallons with water and then sprayed on October 29th.

A second spraying of this was given on November 26th twice as strong as on the first occasion. On November 9th and 10th a third spraying was given with the stock solution undiluted. The amount per tree was about 1½ gallons. The anthracnose then appeared no more and the dry weather did not favour its recrudescence.

He was sure if the vines were not repeatedly sprayed they would have lost all the fruits on the plantation. The plants trained on the Kniffin system were worst affected. The affected leaves and shoots were removed on November 25th and 28th.

Mr. Sundararaman said that Bordeaux mixture was found effective against *Plasmopara viticola* Berk. and Curt. in Madras. The first spraying was of the ordinary strength and the second was weak. Last year 25 sprayers were sold to the cultivators. Holder sprayers of 3½ gallons capacity were used for spraying.

Mr. Bose said that one per cent. Burgundy mixture in the rains and 2 per cent. in cold weather were effective. According to his experience, proprietary Burgundy mixtures, like Blighty Burgundy mixture, were not satisfactory because copper sulphate and soda were mixed in a dry form and an insoluble carbonate was formed, and therefore the precipitate did not remain long in fine suspension. *Rosellinia* was one of their chief troubles. It was very bad in waterlogged clayey soil. The predisposing factor for brown blight was the dryness of the bush. Shade had some influence on the incidence of the disease.

Mr. Sundararaman said that in the Nilgiris good results were obtained against *Rosellinia* of tea and apples by liming and trenching.

The Chairman remarked that in Kumaun in 1917 a healthy group of apple trees was isolated by a deep trench from a neighbouring *Rosellinia* infected group of trees which surrounded it; the entrenched plot had remained healthy so far.

Mr. Narasimhan said that in Mysore 9 years ago coffee plants were uprooted from *Rosellinia* infected fields and pure carbon bisulphide or an emulsion of carbon bisulphide with castor oil was injected into the soil. The field was then replanted with coffee and it had remained healthy so far.

The Chairman enquired if bucket sprayers were replaced by Holder sprayers in Bombay.

Mr. Ajrekar replied that those who could afford to buy a Holder sprayer preferred it to a bucket sprayer but many of the cultivators were too poor to afford a Holder sprayer.

The Chairman enquired if sulphur dusting was practised on a large scale in India.

Mr. Kulkarni said that sulphur dusting against mildews was once attempted in some parts of Bombay but it had been replaced by lime sulphur wash which had been found to be more efficient.

Mr. Sundararaman said that in Madras sulphur dusting was done against mulberry mildew. In Madras the *modus operandi* was that one man sprayed the trees with water and another man followed with a bellows sprayer dusting the wet leaves with flowers of sulphur.

The meeting met again at 1-30 p.m. in the mycological laboratory for a demonstration of spraying machinery and inspection of catalogues of sprayers.

THIRD DAY.

The meeting proceeded to consider—

Subject IV.—Mycological education.

The Chairman said that at the last meeting the subject of mycological education was fully discussed, and that if there was no fresh information on this subject he would welcome suggestions as to how the experience and resources which they had at Pusa could be made available to the mycological workers in the provinces, especially in the new mycological sections.

Mr. Dey said that the teaching in the new departments was handicapped for want of herbarium specimens and therefore Pusa should supply that want.

The Chairman remarked that Pusa had always supplied specimens to the provinces and they were always ready to meet the wants of the provinces as far as possible.

Mr. Sundararaman suggested that specimens collected by the provincial workers should be identified at Pusa.

Mr. Dastur pointed out that work was being already done at Pusa.

Mr. Pearl said that as there was a deficiency of publications in some of the provincial sections they could not be in touch with the current literature on the subjects they had under investigation, and therefore he enquired if Pusa could help these sections by bringing to their notice the literature on the subjects concerned.

Mr. Hole said that that was just the work the Imperial Bureau of Mycology would do for the workers in the colonies.

The Chairman said that at Pusa they had an index of mycological literature which was complete only in certain lines on which they had been working. They would be happy to give any references available.

Mr. Ajrekar said that at Pusa there was a large number of drawings of diseases; it would be of great advantage to the provinces if enlarged charts were distributed to the provinces.

The Chairman said that the making of the charts depended on the staff of artists available. He therefore could not promise to supply the charts but he would bear in mind that suggestion. He wished to know if the provincial departments would find it useful to have a copy of the card catalogue of the Pusa herbarium giving the host and fungus indices. If necessary supplementary lists could be issued every four or five years.

The members were unanimously of opinion that such a list would be of great advantage.

Mr. Dastur drew attention of the members to the fact that if the list was to be of real use the Pusa herbarium ought to be a storehouse of specimens of all the fungi known in India, and therefore the co-operation of all the provincial sections and of the mycological workers in India was absolutely essential.

Mr. Dey enquired how men working outside Pusa were to know what specimens were wanting in the Pusa herbarium.

Mr. Dastur replied that any specimens that were sent to Pusa were always welcome, first because they enabled them to keep a record of the distribution of fungi in India, and secondly because there was an increasing demand on Pusa from all parts of the world

for the supply of specimens of Indian fungi. He earnestly urged the members to send specimens of new fungi described by them.

The Chairman said that Dr. Butler was going to publish an Indian fungus flora which would be of great help to all workers in India. The herbarium list included the foreign and exotic specimens in the Pusa herbarium.

Mr. Pearl hoped that if the flora was much delayed a provisional list would be issued.

The Chairman said that if necessary this might be done. Typewritten sheets could be sent to provincial departments and could be copied.

Mr. Sundararaman enquired what action on the resolution No. 9 passed at the last meeting was taken by the Indian Universities. The resolution was:

> "That this meeting desires to call attention to the neglect of mycological science in Indian Universities, and wishes to emphasize the importance of the subject in India, and to urge on the Universities to give courses and found lectureships or chairs in the subject."

The Madras University had arranged for a series of lectures in mycology to be given to the Honours B.A. students.

Mr. Bal said for the Calcutta University B.Sc. course there were already three subjects and it would not be advisable to add to it a fourth subject, *viz.*, mycology, but it could be made a special subject for the post-graduate course. As the University had not considered this resolution it should be again sent to the Universities.

The Chairman pointed out that the transmitting of the resolutions rested with the Government and not with the conference.

Mr. Ajrekar said that the Government had referred that resolution to the Universities for consideration. The Syndicate of the Bombay University were of opinion that the mycological education given at the Poona Agricultural College was sufficient to meet the requirements of that resolution.

Mr. Dey enquired if the models of crop diseases made at Coimbatore could be made for other provinces.

Mr. Sundararaman said that so far no province had asked for those models but he thought that it would be possible to have them made for a province if required.

Dr. Dudgeon said that at the Indian Science Congress held at Nagpur in 1920 it had been decided to start an Indian Botanical

Society. The first meeting of this society was held during the last sessions of the Indian Science Congress at Calcutta. The object of the society was to encourage and promote botanical research in India. It had occurred to him after coming to Pusa that the official mycologists and botanists could considerably help the society. In course of their researches they often came across related problems which belonged to pure botany but they were left untouched by these official workers for want of time. If these problems were brought to the notice of the Council of the Indian Botanical Society they would take care to hand over those problems to suitable young men.

The last subject before the meeting was—

Subject V. Discussion on legislation against fungal diseases and on the Imperial Bureau of Mycology.

Pest Act. Mr. Ajrekar said that there were no arrangements at the ports of Bombay for the inspection of plants or parts of plants imported from places outside India. Sometime an importer made private arrangements with the Agricultural Department for the loan of a trained man to inspect the imported plants or parts of plants at the port of entry. There had been only two occasions when an examination for fungus diseases had been made at the port of entry under the Pest Act.

Consignments of plants and portions thereof were on arrival examined by an Appraiser of the Customs House and were treated with hydrocyanic acid gas. But on account of the limited capacity of the fumigation box only very small consignments of bulbs and plants could be treated. It was impossible to treat large plants. So far only one such consignment had been received, which was from Basra, for the Economic Botanist to the Punjab Government, and therefore it was allowed to pass on the understanding that the plants would be fumigated immediately on arrival at destination by the consignee.

On account of the very serious difficulty of fumigating large plants the Chief Collector of Customs had submitted to the Government that the work of fumigation should be entrusted to an agency other than the Customs House, or that possibly it could be made incumbent on importers to arrange with a local representative of the Agricultural Department to carry out the necessary fumigation on receipt of fees.

Mr. Ajrekar further said that he had invited suggestions from some of the importers of seeds, bulbs and plants in Bombay on the working of the Destructive Insects and Pests Act of 1919.

The Union Agency, Limited, were of opinion that the import of seeds should be licensed and that the licenses should be given only to reliable firms which could produce from a responsible authority a certificate regarding the disease-free condition of the seeds, and that the consignment should be re-examined at the port of entry. They further said that they found that it was quite essential, if the import of seed potatoes was to be allowed, that the licensed firm or firms ought to be allowed to import without the heavy shackles of a customs regulation the operation of which had been found to be detrimental for the immediate receipt of a perishable commodity like potatoes, the customs examination having unavoidably delayed the delivery for an unreasonably long time. That was very well illustrated by an experience of a small shipment of seed potatoes from Japan which they had in 1919. Out of a quantity of about a hundred hundredweights which had landed in Bombay in good condition, they were delivered hardly a hundred-weight after the whole lot lay in the docks awaiting delivery because of customs permission withheld for want of a competent certifying officer.

The Chairman pointed out that the original error was that no certificate was received from the country of origin.

Mr. Sundararaman said that in Madras there were no special arrangements for fumigating or examining imported consignments. He had kept under his observation consignments which were received without a certificate from the port of origin. Ten plants from a consignment of apple trees from Australia were imported by the Botanical Gardens, Madras, were found dead from *Rosellinia* on arrival and 10 more died of the same disease after planting. He had suggested quarantine stations at the ports of entry for segregating imported plants. The Sugarcane Breeding Station at Coimbatore had often sent him for examination consignments of imported sugarcane setts. In three of these consignments setts attacked by *Thielaviopsis* had been found.

The Chairman said that it was evident that the regulations could be observed only in cases of small consignments which could be easily fumigated. It had come to his notice that recently a case of a large consignment of potatoes was allowed by the customs officer to pass without fumigation on the understanding given by the importer that the potatoes would not be used for seed. That seemed to be a very dangerous thing to do, because in spite of the absolute good faith of the importer there might be dangers over which he had no control.

In reply to his enquiry the Chairman was informed that so far no provincial Agricultural Department had been requested to give a certificate for exports of plants or seeds from India.

The Chairman informed the meeting that under notification of the Government of India, dated the 3rd February, 1921, *Fusicladium macrosporum* Kuyger on *Hevea brasiliensis* was a notified disease and the importation of *Hevea* rubber seed and plants from America was restricted to the Agricultural Department of Madras.

Mr. Narasimhan said that in Mysore a Pest Act in connection with the spraying of areca palms had been introduced. This was enforced for a period of two years in those notified areas where the disease was bad, and where a minority of the areca plantation owners neglected or refused to spray their plantations to the detriment of the interests of the majority who sprayed their plantations. The plantations of the minority were sprayed by the State and the spraying expenses were charged as arrears in revenue.

Imperial Bureau of Mycology. Mr. Hole said that he was unfortunately unable to attend the mycological conference held at Pusa in February 1919 at which resolutions were passed approving of the institution of an Imperial Bureau of Mycology in England to serve as a centre for the accumulation and distribution of information on the diseases of plants in the British Empire. Being at present the official representative of Indian forest botany he should, if possible, like to have it recorded on the minutes of the conference that, from the point of view of Indian forest botany, the institution of this Bureau was heartily welcomed, and it was believed that it would be of great value to them in the Forest Department in their study of plant diseases.

The Chairman said that before bringing the conference to a close he would like to have the views of the meeting as to when and where the next conference should meet. With regard to the frequency of these meetings he could not help noticing in the " Crop Diseases Survey " that they had not had much to say which had not been already said at the last conference. That meant that either they were meeting too frequently or that the survey of crop diseases was not essential at every conference. However he thought that the next meeting should not be later than February 1923 because he hoped the new mycologists would then have a good deal to tell them. As regards the place of meeting he was always glad to see them at Pusa but he would welcome suggestions.

Mr. Sundararaman suggested Coimbatore subject to the Madras Government's approval. This suggestion was approved by the meeting.

Mr. Hole said that on his behalf and that of the visitors he wished to express their appreciation of the Chairman's able conduct of the meeting and of the great help that they had received from him, Mr. Dastur and the staff who spared no pains to make their visit interesting and profitable.

Mr. Pearl wished to associate himself with all that Mr. Hole had said and thanked the Chairman, Mr. Dastur, Mr. Mitra and the staff for all the trouble they had taken.

Dr. Shaw, in reply, said that these meetings were always a source of the greatest help and pleasure to the staff of the mycological section. During the months immediately preceding the present meeting they had been seriously hampered in making adequate preparations by the absences among the senior staff, but at the next meeting they should be at full strength and he hoped that they would receive suggestions for subjects for discussion from workers in the provinces. On behalf of his colleagues, Mr. Dastur and Mr. Mitra, and the Pusa staff he thanked Mr. Hole and the meeting for their appreciation.

In the afternoon the meeting heard lectures from Major de Mello and Mr. S. R. Mudaliyar.

Before reading his **paper** which indicated the lines **on** which agricultural mycologists could help **medical mycology**, Major Froilano de Mello expressed his regret at the absence of Dr. Butler and wished him success in the new post to which he was appointed.

The lecturer pointed out that medical mycology was advancing very slowly in spite of the excellent researches of Remack, Schonlein, Gruby and Malmsten which were carried out nearly a century ago, and that he was sure that this promising branch of human science should not be neglected by medical pathologists in India, where he knew from personal experience that human mycoses were widely spread, the most important being those which simulated tuberculosis. Since 1919, the only work done in this country was by Sur Taraknat who had investigated three cases of human actinomycoses. Even outside India, medical mycology was so much neglected that in the "Tropical Diseases Bulletin" a special section was not allotted for this branch of tropical diseases.

In the last two years only a few investigations in medical mycology had been undertaken. In the Ivory Coast, nodular affections had been found to be caused by *Scopulariopsis*, *Acremonium*, *Cephalosporium* and *Hyalopus*; one case of Jolly with ademitis simulating plague bubo had been traced to *Nocardia*. In Brazil, the possibility of Hodgkin's disease being due to a polymorphous fungus had been shown. In China cases of bronchomoniliase had been observed to produce symptoms of phthisis. In South Africa the pathogene of pijper was found to be *Nocardia pijperi*. The Brazilian yeast, *Oidium brasiliensis*, was discovered to produce clinical symptoms of pseudotuberculosis when inoculated in animals.

Sprue was shown to be caused by *Monilia enterica* and *M. psilosis*. In Brazil, Maduromycosis was discovered to be due to *Discomyces bahiensei* and *Madurella ramisoi*. Some cases of onychosis were discovered to be caused by *Penicillium brevicaule*, *Spicaria* and *Sterigmatocystis*, and, in Peru, *Malassezia* caused by a mycosis of rodents.

These were the only investigations in medical mycology in various parts of the world during the past two years. And yet in India there were numerous mycoses, *e.g.*, Sprue, which was an Indian disease, Blastomycosis, which was found in all parts of India, and Maduromycosis, which was rampant in South India.

The lecturer, as a medical man, earnestly requested for the co-operation of the agricultural mycologists who could really give considerable help in the investigations of medical mycology. He then indicated the lines on which the two sciences could co-operate. He divided human mycoses into dermatomycoses and systemic mycoses, and the latter into open and closed mycoses. Closed systemic mycoses caused disease resembling tuberculosis; therefore the first step in the study of lesions of a tubercular type was to make the test for Koch's bacillus. If the test was negative the second step was to isolate the pathogenic fungus.

Another very important group of diseases, in the investigations of which the help of the agricultural mycologist was absolutely required, was that known under the vague term of Blastomycoses. This term meant diseases caused by blastomycetes and therefore its uses were dependent on the botanical classification of a blastomycete. In medical mycology the term blastomycete was used in three different ways: first some used it as synonymous to a fungus and therefore blastomycete was a disease caused by a fungus, secondly it was considered by some as synonymous to yeasts but in a restricted sense, as in actual practice it was restricted to *Saccharomyces; Endomycetes* and *Cryptococcus* were excluded. Finally the term blastomycetes was used (*a*) for those old cases regarding which there was not sufficient information to classify them on modern scientific principles, (*b*) for diseases produced by yeasts which could not be cultivated and classified, (*c*) for those cases for which the term *Cryptococcus* of Kutzing must yet be used in absence of a definite classification of such yeasts. This was the clinical nomenclature which the lecturer strongly supported, as well as the principle that a disease must be named after the correct name of the pathogenic yeasts, *e.g.*, Saccharomyces, Oidiomyces, etc.

Medical authors had not classified yeasts botanically and many were grouped together as *Monilia*. It was absolutely necessary to

have a scientific classification of yeasts and a revision of the families *Saccharomyces, Saccharomycodes, Saccharomycopsis* and *Zygosaccharomyces*. The genera *Torulaspora, Hausenia, Hauseniaspore* and *Pseudosaccharomyces* should be accurately described. The lecturer had already begun some work on the classification; he had revised 17 genera and had described a new genus *Octomyces;* he was sure that the agricultural mycologist could study this subject with great profit to medical mycology.

The problem of the botanical study of yeasts and the classification of diseases caused by yeasts involved the subject of the etiology of Sprue and its relation with those yeasts which parasitize human intestines. Material help could be rendered to medical mycology by agricultural mycologists if yeasts from human intestines were studied and classified.

Another large group of fungi which could be studied with advantage was what was commonly called the *Nocardiæ* but the correct name of that fungus was Discomyces. *Nocardias* were easily mistaken for bacilli by those who were not well acquainted with them. They were found in large numbers either as parasites or saprophytes in plant and animals. Disease caused by *Nocardias* gave many clinical forms, *e.g.*, dermatoses caused by *N. minutis* and *N. pinoyi;* Madura foot caused by *N. maduræ;* actinomycotic mycetoma caused by *N. bovis;* and pulmonary pseudotuberculosis due to *N. bovis* and *N. pulmonalis*. Saprophytic *Nocardias* also occurred in human intestines, in air, water and soil. It was a mistake to suppose that all Maduromycoses of which Madura foot was widely prevalent in South India were due to *N. maduræ*. From this group of destructive diseases several genera had been isolated, *e.g., Nocardia, Madurella, Sadosporium, Glenospora, Sterigmatocystis, Indiella*, etc. Mycologists of South India had excellent opportunities of investigating the pathogenes of Madura foot. The isolation of the pathogenic fungi of Madura foot was very simple, but it was difficult to isolate pathogenic *Nocardias* from intestines and other organs which more or less were liable to external contamination.

The study of Indian dermatomycoses was very interesting but the trouble and difficulty of separating pathogenic fungi from saprophytic fungi in the isolations taken from dermatic scab were very great, and it was perhaps for this reason that there was in India a certain amount of scepticism about medical mycology.

The study of human dermatoses attacking glabrous parts and of the hairy tineæ on animals is particularly difficult and discouraging because of the multitude of saprophytic fungi that contaminate cultures of the pathogene; and the isolation of the

pathogene itself was very troublesome if not impossible. The lecturer therefore was of opinion that in every mycological laboratory of India a study of fungi contaminating cultures of pathogenic fungi would be of considerable help, and for that reason he had already made a beginning in that direction. He was classifying *Aspergillus* and *Sterigmatocystis* found in his laboratory.

The study of animal mycoses was not a scientific curiosity but was of great importance because they were highly contagious and human dermatoses were often caused by contact with infected dogs, cats or fowls.

The Chairman, at the conclusion of the paper, said that once again they had had the privilege of hearing Major de Mello on that subject which he had made peculiarly his own. All realized that medical mycology presented a very wide field for research —a field which in India had been explored only by Major de Mello. It was a matter of surprise to him that greater attention was not paid to the mycological diseases of animals and men in the tropics by the medical profession, and he was sure that all workers in mycological science in India would be ready to advance this fascinating branch of this subject in so far as they could do so. Yeasts had taken on a new significance after what they had just heard, and the suggestion that an investigation of the organisms commonly contaminating cultures in the laboratory should be made had opened a line of research in which all could co-operate. On behalf of the meeting he would thank Major de Mello very heartily for his interesting lecture.

Resolution passed at the Third Meeting of Mycological Workers in India held at Pusa on the 7th February, 1921, and following days.

Subject II.

An effort should be made by Departments of Mycology to keep an annual record of the actual damage, with an estimate of the financial loss involved, done to the principal agricultural and forest crops by the major fungal diseases of the province.

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